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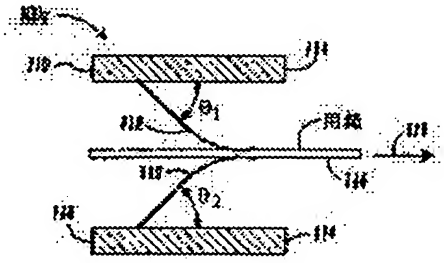
(54) SENSOR SYSTEM TO MEASURE PHYSICAL PROPERTY OF SHEET, AND SHEET TREATMENT DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a system to optimize the sheet handing speed, or the like by detecting the characteristics of the paper sheet, and regulating the setting of a sheet carrying mechanism based on the detected characteristics.
SOLUTION: A paper sheet characteristics sensor system 100a measures the curl and the thickness of the paper sheet using two paper sheet characteristics sensors 110. Each paper sheet characteristics sensor 110 comprises a member 112, a base 114, and a measurement circuit. Two members 112 are arranged opposite to each other, and both members 112 are brought into contact with a sheet 116 when the paper sheet 116 is passed therethrough. Each member 112 is connected to the base 114 including the measurement circuit. Each measurement circuit measures the displacement of a related member.



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CLAIMS

[Claim(s)]
[Claim 1] The part I material and part II material which are the sensor system which measures the physical characteristic of a sheet, are the part I material and the part II material which countered a each other and have been arranged, and touch the sheet which passes through between these both, respectively, b) The first base combined with said part I material, and the second base combined with the c aforementioned part II material, d) The first measurement unit which measures the variation rate of said part I material at the time of being combined with said part I material and said sheet passing through between said part I material and said part II material, e) Sensor system containing the second measurement unit which measures the variation rate of said part II material at the time of being combined with said part II material and said sheet passing through between said part I material and said part II material.
[Claim 2] It is the sensor system characterized by for said part I material giving the first predetermined include angle in a sensor system according to claim 1, and extending from said first base.
[Claim 3] the difference of said first predetermined include angle at the time of said sheet passing through between said part I material and said part II material in a sensor system according to claim 2, as for said first measurement unit -- the sensor system characterized by measuring change.
[Claim 4] Said first measurement unit is a sensor system characterized by reflecting the light from said light source in said optical position transducer from said part I material in a sensor system according to claim 3, including the light source and an optical position transducer further.
[Claim 5] It is the sensor system characterized by including further the strain gauge which said first measurement unit is combined with said part I material in a sensor system according to claim 3, and measures the deflection of said part I material.
[Claim 6] The sheet conveyance device to which it is a sheet processor, and a control signal is answered and a sheet is moved, b) The controller which is combined with said sheet conveyance device, answers the first property signal, and generates said control signal, c) The sensor system which is combined with said sheet conveyance device and generates said first property signal, an implication and said sensor system -- 1 -- with the part I material and the part II material which are the part I material and the part II material which countered mutually and have been arranged, and touch the sheet which passes through between these both, respectively 2) -- the first base combined with said part I material, and 3 -- with the second base combined with said part II material 4) The first measurement unit which measures the variation rate of said part I material to said first base at the time of being combined with said first base and said sheet passing through between said part I material and said part II material, 5) Sheet processor equipped with the second measurement unit which measures the variation rate of said part II material to said second base at the time of being combined with said second base and said sheet passing through between said part I material and said part II material.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention detects the physical characteristic of the sensor system which detects the physical characteristic of a sheet, and a sheet, and relates to the sheet processor which controls sheet conveyance based on this detection result.
[0002]
[Description of the Prior Art] From the recordable medium of paper etc., the quality of the text in which read-out or writing is performed with a laser beam printer, a xerography printer, a scanner, or an ink jet printer, or an image is greatly influenced by the physical characteristic of a medium. Each of the thickness of the medium recorded, curl, mass, and rigidity influences the precision at the time of the medium imprint of the rate at which a printer conveys a recordable medium sheet, accuracy and a text, or an image. Generally, the class of sheet (form) with which a printer or a copy machine can operate well is restricted, and a form conveyance device and image copy must be optimized about the specific class. When extreme, in order to acquire suitable printing quality, only the form with which it is the form which is supplied by the manufacturer, and which was developed specially, and the original condition immediately after manufacture is maintained, and it does not bend, but it is maintained at fixed humidity level, and the deflection of paper is controlled can be used. Even if a form is too thick, it is too thin or it has bent only slightly, the danger of becoming the hindrance of a paper jam or a form conveyance device may be increased.
[0003]
[Problem(s) to be Solved by the Invention] Using various form type setup, even if it does not necessarily use for a printer, a copy machine, and scanners that a setup of the form of varieties is possible, then the specific form which prevents the conveyance error of a form and a manufacturer supplies, image quality can be improved. For example, when sending a thick form or a thin board to a form conveyance device, a user sets the thickness of a form as "thick" manually. Then, spacing and the bearer rate between pinch rollers are adjusted automatically, and compensate the thickness of the form which became thick. Though regrettable, by this solution approach, the excessive effort that a user specifies the exact grade or the exact class of recordable medium supplied to a printer is needed. Furthermore, this system has a little complicated actuation, when the form of varieties is mixed. It is because the form of varieties is sent to a form conveyance device, so a setup of the thickness of a form of "being thick" must always be turned on / turned off.
[0004] Therefore, based on the property of a sheet of having detected the property of a sheet (form) automatically and having detected it, a setup of a sheet conveyance device is adjusted automatically, and the cheap form processing system of costs which optimizes the description on form conveyance of the handling rate of a sheet, spacing, or others is needed. In such a system, a user input is the minimum, ends, optimizes the sheet processing description automatically, and can apply it to the sheet and sheet condition of varieties. for this reason -- this -- a sheet -- a processor -- quality -- a consistency (consistency) -- differing -- recycle -- possible -- a sheet -- use -- promoting -- and -- quality -- being low -- or -- a few -- damage -- it is -- a sheet -- use -- a sheet -- futility -- stopping -- while -- new -- manufacturing -- having had -- being unhurt -- a sheet -- having used it -- a case -- matching -- a sheet -- conveyance -- a result -- being shown -- things -- being possible .
[0005] Moreover, the form processing system which offers the information about a sheet property and can optimize the adjustment in image copy is also needed. In this system, if

heat capacity, thermal conductivity, a dielectric constant, or the sheet property of resistance is determined before an image imprint, image copy can be optimized so that a text or an image may be imprinted as much as possible to best. For example, if the heat conductivity of a sheet is known, the temperature control of the toner joining module of a xerography printer is performed, and a toner particle can be established the the best for a form, without wasting energy with unnecessary heating of the sheet leading to sheet damage.

[0006] This invention offers a suitable sensor system to detect the physical characteristic of a sheet, and aims at enabling automatic adjustment of many properties on the handling of a sheet in equipments, such as a copying machine and a printer.

[0007]

[Means for Solving the Problem] With one gestalt of the sensor system concerning this invention, curl and thickness of a sheet are measured using two sensors. Each sensor includes a member, the base, and a measuring circuit. Two members of that in both sensors counter mutually, and are arranged, and the sheet of the recordable medium which passes through between both [these] members is contacted. These each part material is combined with the base, and the base is equipped with a measuring circuit. Each measuring circuit measures the variation rate of the related member and the related base. With other gestalten of a sensor system, the rigidity of a sheet and curl are measured using the device which opened spacing and has arranged two pairs of pairs of the sensor which counters. With the gestalt of further others of a sensor system, the thermometric conductivity of a sheet is measured using three sensors. One of the sensors is equipped with the heater which heats a sheet, and other two sensors are equipped with the thermocouple which contacts a sheet and detects the heat of a sheet.

[0008]

[Embodiment of the Invention] Drawing 1 shows the copying machine 9 which applies the form property sensor system 100 of this invention. The form property sensor system 100 makes operating of the sheet of the recordable medium change into a copying machine 9 according to the property of the recordable medium by which current feeding is carried out into the copying machine 9. Moreover, the form property sensor system 100 is applicable to every equipment which uses ingredients, such as a transparent-material (used for OHP etc.) metallurgy group, plastics, and a silicon wafer. When it explains briefly, the operation gestalt of the form property sensor system 100 contains one or more form property sensors. Each sensor is equipped with the member combined with the base and a measurement unit. The various properties of the medium under conveyance are searched for by measurement of the amount of displacement to the base of this member. The detail of the form property sensor system 100 is explained according to drawing 2 - drawing 14 .

[0009] A. Consider the copying machine 9 shown in drawing 1 before explaining more the form property sensor system 100 of copying machine this invention to a detail. A copying machine 9 is equipped with the belt 10 which has a photoconduction front face. A belt 10 moves in the direction of the arrow head 12 in drawing, and passes each processing station for each part on the front face of a photoconduction sequentially from an electrification station. An electrification station contains the corona generator 14 which electrifies a photoconduction front face in almost uniform, comparatively high potential.

[0010] A photoconduction front face advances from an electrification station to an imaging station. At an imaging station, the document processing system unit 15 arranges a manuscript 16 in the condition of having turned the side front to the exposure system

17. The exposure system 17 is equipped with the lamp 20 which irradiates a document 16 on the transparence platen 18. The beam of light reflected from the document 16 collects light on the electrification part of a belt 10 through a lens 22, and carries out stripping of the charge alternatively. This records the electrostatic latent image of a manuscript 16 on the photoconduction front face of a belt 10.

[0011] A platen 18 is installed movable, moves in the direction of the arrow head 24 in drawing, and adjusts the scale factor of the manuscript under copy. A lens 22 moves synchronizing with a platen 18, and collects the light figures of a manuscript 16 to up to the electrification part of a belt 10.

[0012] From a maintenance tray, the document processing system unit 15 carries out recycling of the sheet to the manuscript stack supported by delivery and this tray one after another in the manuscript to the platen 18, and returns it to it. Then, a belt 10 advances an electrostatic latent image to a development station.

[0013] At a development station, the magnetic brush developing rollers 26 and 28 of a pair contact a development counter and the electrostatic latent image on a belt 10. An electrostatic latent image draws a toner particle from a development counter, and forms a toner powder image on a belt 10.

[0014] A belt 10 goes to an imprint station after the development of an electrostatic latent image. At an imprint station, a copy paper (sheet) and a toner powder image are contacted. An imprint station equips the background of a copy paper with the generator 30 which injects ion. In this way, the toner powder image on the photoconduction front face of a belt 10 is drawn to a copy paper.

[0015] A copy paper is fed to an imprint station from either of the trays 34 or 36. A conveyor 32 carries forward a sheet to the joining station 40 after a toner image imprint. The joining station 40 is equipped with the FUYUZA assembly which makes a copy paper carry out permanent fixing of the imprinted toner powder image. Suitably, the FUYUZA assembly 40 is equipped with the roller 42 and backup roller 44 which were heated.

[0016] The form property sensor system 100 is installed in the convenient location between the copy paper trays 34 and 36 and a conveyor 32 in a copy paper conveyance path, and is suitably installed in the copy paper tray 34 and about 36. Using the information given from the form property sensor system 100, between speed regulation of conveyors 32, 37, and 46 and nip (nip) 39, and 41 and between rollers 42-44, a controller 38 performs spacing adjustment of the gates 48 and 52 and the judgment gate 52, and can prevent a paper jam.

[0017] A controller 38 contains a processor and memory. By executing the instruction of the control instruction of the form property sensor system 100 electronically memorized by memory etc., a processor controls and adjusts actuation of a copying machine 9. The instruction showing the approach explained on these specifications is realizable by the suitable machine language of arbitration. Semi-conductor logical elements usable to memory implementation are a read-only memory (ROM), random access memory (RAM), dynamic random access memory (DRAM), Programmable Read Only Memory (PROM), eliminable Programmable Read Only Memory (EPROM), read-only memories (EEPROM) (flash memory etc.) eliminable electric, etc.

[0018] B. The first operation gestalt of a form property sensor system (the thickness and for curl measurement) [of a form]

Drawing 2 shows first operation gestalt 100a of the form property sensor system 100 in which measurement with the thickness of a sheet and curl is possible. Wiring between form property sensor system 100a and a controller 38 is not shown in drawing 2 and

drawing after this. Form property sensor system 100a contains the form (sheet) property sensor 110 of the pair which countered mutually. This form property sensor 110 is used for all the operation gestalten of a form property sensor system. For this reason, especially in the following explanation, unless it points out, the sensor 110 mentioned here shall be applied to every system 100.

[0019] Each form property sensor 110 contains the member 112 which is combined with the base 114 and prolonged in a longitudinal direction from the base 114. Each base 114 is equipped with the measuring circuit for measuring the include angle theta to the base 114 of this member 112. Measurement of each property is performed while passing a form (sheet) 116 contacting these members 112 in between two member 112 comrades, and making it deform these members 112.

[0020] Preferably, the form property sensor 110 is produced as detailed electric machine mold (MEM mold) equipment using standard semi-conductor batch manufacture and a wafer processing technique. By this approach, form property sensor 110a is producible as equipment of the dimension of millimeter order with several [only] yen manufacturing cost. Although the function top of the form property sensor 110 does not need to be such a detailed dimension like this, if larger-scale equipment is produced using other techniques, the cost per sensor will become high.

[0021] As shown in drawing 2 , it is realizable as a slender arm prolonged in a longitudinal direction from the base 114, but a member 112 is good as for spring 112a, as shown in drawing 3 . Both can produce the member 112 shown in drawing 2 R> 2 and drawing 3 , or member 112a using the ingredient of a low quality amount by processing in which breathe out a thick metallic-coating layer or the spring beforehand formed on silicon or glass using the sacrifice lower layer for electric anticorrosion (sacrificial underlayer) is joined. Moreover, when not producing the form property sensor 110 with a batch semi-conductor processing technique, a member 112 can be realized by other approaches. In drawing 4 , a member 112 is realized as a plunger 113 carried in the spring 115. In this case, a sheet's 116 passage of on a roller 117 goes up or drops a plunger 113 along with the arrow head 111 in drawing with a spring 115. A plunger 113 is combined at right angles to the base 114 so that it may illustrate. A plunger 113 is combined at a shallower include angle, and you may make it not bar a motion of a sheet 116. The bulb by which a solenoid drive is carried out may be substituted for a plunger 113. The include angle between a member 112 and the base of relation changes with the deflections of the member 112 also according [which case] to a sheet 116. Although the example at the time of realizing a member 112 as an arm is hereafter explained to representation, the following explanation shall be applied to all the operation gestalten of not only an arm but the member 112.

[0022] Drawing 5 shows first operation gestalt 110a of the form property sensor 110. base 114a -- the light source 120 -- it has light emitting diode (LED) and a position transducer 122 suitably. A position transducer 122 detects the light from LED120 deflected with the sensor arm 112. The signal which the location where light shines upon a position transducer 122 changes, consequently is outputted to a controller 38 from a measuring circuit by change of the include angle of the sensor arm 112 and the base 114 to build changes. Drawing 6 shows second operation gestalt 110b of the sheet property sensor 110. With this operation gestalt, a measuring circuit contains the strain gauge 124 combined with the sensor arm 112 and the base 114. A strain gauge 124 may be included in the base 114 attached in the sensor arm 112 and this sensor arm 112, or may be attached between the sensor arm 112 and the base 114. If the include angle between the sensor arm 112 and the base 114, i.e., deflection ** of the sensor arm 112, changes, the

signal which the strain detected by the strain gauge 124 changes, consequently is sent to a controller 38 from a measuring circuit will change. A strain gauge 124 can detect a strain using a piezoresistance or piezoelectricity.

[0023] Form property sensor system 100a is measurable in the thickness of a form sheet, and curl using either of the form property sensors 110a or 110b. Between the sensor arms 112, it starts from the condition that there is no sheet 116, and measurement of the thickness of a form calculates differential offset displacement thetaoffset. It is theta offset=theta 1 offset-theta 2offset. Then, differential displacement thetawp is calculated in the condition that a form 116 is between the sensor arms 112. It is theta wp=theta 1 wp-theta 2wp. The thickness of a form 116 is called for by the controller 38 using thetawp and thetaoffset. differential [in / on the other hand, measurement of curl of a form is in the condition which has a form 116 between the form property sensors 110 first, and / the 1st time amount] -- a variation rate thetatau1 is measured. the 2nd time amount which is still between the sheet property sensors 110 although a form 116 begins migration from there -- setting -- differential -- a variation rate thetatau2 is measured. A controller 38 searches for the difference of thetatau2 and thetatau1 as an indicator of curl of a sheet. It turns out that curl is so large that this difference is large.

[0024] C. The second operation gestalt of a form property sensor system (for form mass measurement)

Drawing 9 shows operation gestalt 100b for form mass measurement of the form property sensor system 100. System 100b includes the modification of the form property sensor 110 in which the position control of the sensor arm 112 is possible. The example of a complete-change form of form property sensor 110c of drawing 7 is shown in drawing 9 . This form property sensor 110c is equipped with the perpendicular actuator 126 combined between the sensor arm 112 and the base 114. The perpendicular actuator 126 may be used together with one of the measuring circuits which was explained according to drawing 5 and drawing 6 . There are for example, a piezo-electric bimorph element, a linear piezo-electric element which the mechanical amplifier attached, a bubble drive mold micro piston, etc. in a device available to implementation of the perpendicular actuator 126. Form property sensor 110d as shown in drawing 8 may be used for form property sensor system 100b, and, instead, the linear actuator 119 for moving an arm 112 is used instead of the perpendicular actuator 126 in that case.

[0025] Form property sensor system 100b includes the circuit 140 for detecting a motion of the sensor arm 112. A circuit 140 gives the output of a strain gauge 124 to an operational amplifier 142. an operational amplifier 142 -- difference -- it functions as amplifier. A low pass filter 144 separates the high frequency component of the differential signal outputted from the operational amplifier 142, and enables a faithful feedback trace. Then, after the analog output from a filter 144 is changed into a digital signal by the A-D converter, it is sent to a controller 38. An A-D converter may be incorporated into a controller 38.

[0026] In order to perform form mass measurement using form property sensor system 100b, a signal is first given from a controller 38 to an actuator 126, and the normal impact force of the fixed amplitude is applied to the sensor arm 112 in the condition that there is no form 116 between the sensor arms 112, according to this signal. And differential displacement (differentialdisplacement) thetabase is detected by the measuring circuit, and it is sent to a controller 38, and becomes comparison criteria. Then, the normal impact force of the as same magnitude as the point is applied to the sensor arm 112 in the condition that a form 116 is between the sensor arms 112, and it is differential displacement thetaload. It is detected. A controller 38 takes the difference of

thetabase and thetaload and presumes the mass of a form 116.
[0027] D. The third operation gestalt of a form property sensor system (curl of a form, and for rigid measurement)
Drawing 10 shows operation gestalt 100c curl of the form sheet of the form property sensor system 100, and for rigid measurement. the sensor pair which consists of a form property sensor 110 by which this form property sensor system 100c countered -- 150 and 152 are included. A perpendicular actuator or a linear actuator may be added to the form property sensor 110 so that a member 112 and a form 116 may contact certainly. the sensor pair which is a pair of the form property sensor which counters in order to ask for curl of a form sheet using system 100c -- the condition that a form 116 is between 150 and 152 -- differential -- a variation rate is detected to coincidence by both sensor pairs. two obtained differential -- a variation rate -- the difference of a between serves as an index of curl of a form, and it is used for modification of the copying machine 9 by the controller 38 of operation. Moreover, if the first sensor pair of the form property sensor 110 is equipped with the perpendicular or the linear actuator, form property sensor system 100c can also perform rigid measurement of a form. first, the form 116 -- a sensor pair -- the condition of being in contact with both 150 and 152 -- a sensor pair -- normal force is applied to 150. while [and] the normal force is still applied -- a sensor pair -- the differential of the sensor arm 112 of 152 -- a variation rate is measured. in this way, the detected differential -- a variation rate serves as an index which shows the rigidity of a form 116.
[0028] E. The fourth operation gestalt of a form property sensor system (for thermal-diffusivity measurement of a form)
Drawing 11 shows 100d of fourth operation gestalt of the form property sensor system 100. This system 100d, the thermal diffusivity of the form sheet 116 can be measured directly, and that coefficient of friction can be measured indirectly. Form property sensor system 100d, the form property sensors 110d, 110e, and 110f are included. The form property sensors 110d and 110e face each other perpendicularly, are arranged, on the other hand, sensor 110f, open sensor 110d and spacing and are arranged horizontally. Form property sensor 110d, it has the heater 160 attached in the sensor arm 112d edge in contact with a sheet 116. A heater 160 is a resistance mold heater which is installed on sensor arm 112d, or is included in this sensor arm. A heater 160 is driven according to sinusoidal current or the impulse current. The form property sensors 110e and 110f are equipped with the temperature sensing devices 162e and 162f installed on the sensor arm 112, respectively, and it is made for these temperature sensing devices 162e and 162f to be touched by the form 116. The temperature sensing devices 162e and 162f are realizable as a thin film thermocouple or a temperature sensing resistor. A perpendicular or a linear actuator may be added to the form property sensors 110d, 110e, and 110f so that the sensor arms 112d, 112e, and 112f and a form 116 may contact certainly. Moreover, thin layer coating is given with Si3N4 or a diamond on the sensor arms 112d and 112e and 112f, and you may make it protect this sensor arm group from wear by the form 116.
[0029] In order to detect the thermal diffusivity of a perpendicular or a longitudinal direction, while the form 116 is standing it still, sinusoidal current or the impulse current is added to a heater 160. Then, form property sensor 110e detects the heat given from the heater 160 in between [that the sheet 116 has still stood it still], and generates the signal which shows the thermal diffusivity of the perpendicular direction of a form 116 from thermocouple (temperature sensing device) 162e. Similarly, while the form 116 is standing it still, form property sensor 110f, heat is detected through 162f (temperature

sensing device) of thermocouples, and the signal which shows the thermal diffusivity of the longitudinal direction of a form 116 is outputted.
[0030] F. The fifth operation gestalt of a form property sensor system (for coefficient-of-friction measurement of a form)
Drawing 12 shows operation gestalt 100e for coefficient-of-friction measurement of the form 116 of the form property sensor system 100. Form property sensor system 100e is equipped with 162g of temperature sensing devices this sensor 110g including form property sensor 110g. It is realizable device 162g using a thermocouple or a temperature sensing resistor. If this system 100g is used, coefficient of friction of a form sheet can be indirectly measured by at least three kinds of following approaches.
[0031] In a primary method, form property sensor 110g is made to pass a form 116, and 162g of temperature sensing equipment performs temperature detection of a form 116. The temperature rise acquired is proportional to coefficient of friction and the form rate, the pressure, ambient temperature, and form temperature of a form. Therefore, in order to measure coefficient of friction correctly by this approach, it is necessary to proofread a copying machine 9 according to this factor group, or to maintain this factor group uniformly. By the second approach of measuring coefficient of friction indirectly, a form 116 is first made into a short period of time and a quiescent state, and 162g of temperature sensing devices is proofread. 162g of temperature sensing equipment is made to pass a form 116 after proofreading, and 162g of these equipment is made to detect the temperature of a form 116. The difference between the temperature detected under migration of a form 116 at the time of quiescence expresses coefficient of friction of a form 116. Moreover, in order to use the third approach, a linear actuator or a perpendicular actuator is added to form property sensor 110g. In case a form 116 passes form property sensor 110g with constant speed by this, the sensor arm 112 is moved to a longitudinal direction along with a form 116 by the actuator. If theta is measured at the time of this actuation, the index of coefficient of friction will be obtained.
[0032] If the temperature sensing device 162 is omitted, it is deformable so that coefficient of friction can be measured directly for system 100e. In order to measure a request, a form 116 is maintained at a quiescent state, form property sensor 110g, it crosses a form 116, is pushed (meeting) and measures the amount theta of displacement which expresses coefficient of friction between them.
[0033] Drawing 13 shows form property sensor system 100f too usable to indirect measurement of coefficient of friction. Independent form property sensor 110h without a thermocouple is included system 100f. Unlike the form property sensor explained so far, the shaft of the longitudinal direction of the base 114 is established at right angles to the front face of a form 116. In order to measure coefficient of friction of a form using this system 100f, a motion of the longitudinal direction of a form 116 is adjusted in the condition of having made form property sensor 110h fixing. Then, the deflection of the sensor arm 112 arises for friction association by the form 116 and the reaction of an arm 112.
[0034] G. The sixth operation gestalt of a form property sensor system (the dielectric constant and for resistance measurement) [of a form]
Drawing 14 shows the dielectric constant of the form 116 of the form property sensor system 100, and 100g of operation gestalten for resistance measurement. Form property sensor system 100g, the form property sensors 110i and 110j by which the pair countered are included. Both of the sensors 110i and 110j are equipped with the perpendicular actuator 126 for contacting a form 116 certainly. The perpendicular actuator 126 is omissible if needed. Moreover, each form property sensors 110i and 110j equip the edge

of the related sensor arm 112 with Electrodes 170g and 170h, respectively. Both the electrodes 170g and 170h contact a form 116.
[0035] In order to measure a dielectric constant, a sine wave or impulse voltage is applied to 170g of electrodes, and the electrical potential difference is driven to 170h of electrodes through a form 116. The current of the different phase detected by 170h of electrodes is proportional to the electrostatic capacity between 170g-170h of electrodes (capacitance). From electrostatic capacity C and a dielectric constant epsilon, it can ask according to a degree type.
[0036]
[Equation 1] C=epsilon A/d -- here, A expresses an electrode surface product and d expresses the thickness of a form.
[0037] Thickness d of a form 116 can be measured using the approach shown in drawing 2 to, have explained form property system 100a by the way.
[0038] Resistance of a form 116 is measurable by detecting a current in phase by 170h of electrodes, applying a sine wave or impulse voltage to 170g of electrodes too. It depends for this current showing resistance greatly to the temperature of the moisture regain of a form 116, and the second form 116 in the first place. Therefore, a copying machine 9 keeps these amounts constant, or needs to be proofread in accordance with these amounts. Instead a controller 38 can use change of the current detected by 170h of electrodes, and the moisture regain and temperature of a form 116 can also be presumed.

TECHNICAL FIELD

[Field of the Invention] This invention detects the physical characteristic of the sensor system which detects the physical characteristic of a sheet, and a sheet, and relates to the sheet processor which controls sheet conveyance based on this detection result.

PRIOR ART

[Description of the Prior Art] From the recordable medium of paper etc., the quality of the text in which read-out or writing is performed with a laser beam printer, a xerography printer, a scanner, or an ink jet printer, or an image is greatly influenced by the physical characteristic of a medium. Each of the thickness of the medium recorded, curl, mass, and rigidity influences the precision at the time of the medium imprint of the rate at which a printer conveys a recordable medium sheet, accuracy and a text, or an image. Generally, the class of sheet (form) with which a printer or a copy machine can operate well is restricted, and a form conveyance device and image copy must be optimized about the specific class. When extreme, in order to acquire suitable printing quality, only the form with which it is the form which is supplied by the manufacturer, and which was developed specially, and the original condition immediately after manufacture is maintained, and it does not bend, but it is maintained at fixed humidity level, and the deflection of paper is controlled can be used. Even if a form is too thick, it is too thin or it has bent only slightly, the danger of becoming the hindrance of a paper jam or a form conveyance device may be increased.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Using various form type setup, even if it does not necessarily use for a printer, a copy machine, and scanners that a setup of the form of

varieties is possible, then the specific form which prevents the conveyance error of a form and a manufacturer supplies, image quality can be improved. For example, when sending a thick form or a thin board to a form conveyance device, a user sets the thickness of a form as "thick" manually. Then, spacing and the bearer rate between pinch rollers are adjusted automatically, and compensate the thickness of the form which became thick. Though regrettable, by this solution approach, the excessive effort that a user specifies the exact grade or the exact class of recordable medium supplied to a printer is needed. Furthermore, this system has a little complicated actuation, when the form of varieties is mixed. It is because the form of varieties is sent to a form conveyance device, so a setup of the thickness of a form of "being thick" must always be turned on / turned off.

[0004] Therefore, based on the property of a sheet of having detected the property of a sheet (form) automatically and having detected it, a setup of a sheet conveyance device is adjusted automatically, and the cheap form processing system of costs which optimizes the description on form conveyance of the handling rate of a sheet, spacing, or others is needed. In such a system, a user input is the minimum, ends, optimizes the sheet processing description automatically, and can apply it to the sheet and sheet condition of varieties. for this reason -- this -- a sheet -- a processor -- quality -- a consistency (consistency) -- differing -- recycle -- possible -- a sheet -- use -- promoting -- and -- quality -- being low -- or -- a few -- damage -- it is -- a sheet -- use -- a sheet -- futility -- stopping -- while -- new -- manufacturing -- having had -- being unhurt -- a sheet -- having used it -- a case -- matching -- a sheet -- conveyance -- a result -- being shown -- things -- being possible .

[0005] Moreover, the form processing system which offers the information about a sheet property and can optimize the adjustment in image copy is also needed. In this system, if heat capacity, thermal conductivity, a dielectric constant, or the sheet property of resistance is determined before an image imprint, image copy can be optimized so that a text or an image may be imprinted as much as possible to best. For example, if the heat conductivity of a sheet is known, the temperature control of the toner joining module of a xerography printer is performed, and a toner particle can be established the the best for a form, without wasting energy with unnecessary heating of the sheet leading to sheet damage.

[0006] This invention offers a suitable sensor system to detect the physical characteristic of a sheet, and aims at enabling automatic adjustment of many properties on the handling of a sheet in equipments, such as a copying machine and a printer.

MEANS

[Means for Solving the Problem] With one gestalt of the sensor system concerning this invention, curl and thickness of a sheet are measured using two sensors. Each sensor includes a member, the base, and a measuring circuit. Two members of that in both sensors counter mutually, and are arranged, and the sheet of the recordable medium which passes through between both [these] members is contacted. These each part material is combined with the base, and the base is equipped with a measuring circuit. Each measuring circuit measures the variation rate of the related member and the related base. With other gestalten of a sensor system, the rigidity of a sheet and curl are measured using the device which opened spacing and has arranged two pairs of pairs of the sensor which counters. With the gestalt of further others of a sensor system, the thermometric conductivity of a sheet is measured using three sensors. One of the sensors

is equipped with the heater which heats a sheet, and other two sensors are equipped with the thermocouple which contacts a sheet and detects the heat of a sheet.
[0008]
[Embodiment of the Invention] Drawing 1 shows the copying machine 9 which applies the form property sensor system 100 of this invention. The form property sensor system 100 makes operating of the sheet of the recordable medium change into a copying machine 9 according to the property of the recordable medium by which current feeding is carried out into the copying machine 9. Moreover, the form property sensor system 100 is applicable to every equipment which uses ingredients, such as a transparent-material (used for OHP etc.) metallurgy group, plastics, and a silicon wafer. When it explains briefly, the operation gestalt of the form property sensor system 100 contains one or more form property sensors. Each sensor is equipped with the member combined with the base and a measurement unit. The various properties of the medium under conveyance are searched for by measurement of the amount of displacement to the base of this member. The detail of the form property sensor system 100 is explained according to drawing 2 - drawing 14 .
[0009] A. Consider the copying machine 9 shown in drawing 1 before explaining more the form property sensor system 100 of copying machine this invention to a detail. A copying machine 9 is equipped with the belt 10 which has a photoconduction front face. A belt 10 moves in the direction of the arrow head 12 in drawing, and passes each processing station for each part on the front face of a photoconduction sequentially from an electrification station. An electrification station contains the corona generator 14 which electrifies a photoconduction front face in almost uniform, comparatively high potential.
[0010] A photoconduction front face advances from an electrification station to an imaging station. At an imaging station, the document processing system unit 15 arranges a manuscript 16 in the condition of having turned the side front to the exposure system 17. The exposure system 17 is equipped with the lamp 20 which irradiates a document 16 on the transparence platen 18. The beam of light reflected from the document 16 collects light on the electrification part of a belt 10 through a lens 22, and carries out stripping of the charge alternatively. This records the electrostatic latent image of a manuscript 16 on the photoconduction front face of a belt 10.
[0011] A platen 18 is installed movable, moves in the direction of the arrow head 24 in drawing, and adjusts the scale factor of the manuscript under copy. A lens 22 moves synchronizing with a platen 18, and collects the light figures of a manuscript 16 to up to the electrification part of a belt 10.
[0012] From a maintenance tray, the document processing system unit 15 carries out recycling of the sheet to the manuscript stack supported by delivery and this tray one after another in the manuscript to the platen 18, and returns it to it. Then, a belt 10 advances an electrostatic latent image to a development station.
[0013] At a development station, the magnetic brush developing rollers 26 and 28 of a pair contact a development counter and the electrostatic latent image on a belt 10. An electrostatic latent image draws a toner particle from a development counter, and forms a toner powder image on a belt 10.
[0014] A belt 10 goes to an imprint station after the development of an electrostatic latent image. At an imprint station, a copy paper (sheet) and a toner powder image are contacted. An imprint station equips the background of a copy paper with the generator 30 which injects ion. In this way, the toner powder image on the photoconduction front face of a belt 10 is drawn to a copy paper.

[0015] A copy paper is fed to an imprint station from either of the trays 34 or 36. A conveyor 32 carries forward a sheet to the joining station 40 after a toner image imprint. The joining station 40 is equipped with the FUYUZA assembly which makes a copy paper carry out permanent fixing of the imprinted toner powder image. Suitably, the FUYUZA assembly 40 is equipped with the roller 42 and backup roller 44 which were heated.

[0016] The form property sensor system 100 is installed in the convenient location between the copy paper trays 34 and 36 and a conveyor 32 in a copy paper conveyance path, and is suitably installed in the copy paper tray 34 and about 36. Using the information given from the form property sensor system 100, between speed regulation of conveyors 32, 37, and 46 and nip (nip) 39, and 41 and between rollers 42-44, a controller 38 performs spacing adjustment of the gates 48 and 52 and the judgment gate 52, and can prevent a paper jam.

[0017] A controller 38 contains a processor and memory. By executing the instruction of the control instruction of the form property sensor system 100 electronically memorized by memory etc., a processor controls and adjusts actuation of a copying machine 9. The instruction showing the approach explained on these specifications is realizable by the suitable machine language of arbitration. Semi-conductor logical elements usable to memory implementation are a read-only memory (ROM), random access memory (RAM), dynamic random access memory (DRAM), Programmable Read Only Memory (PROM), eliminable Programmable Read Only Memory (EPROM), read-only memories (EEPROM) (flash memory etc.) eliminable electric, etc.

[0018] B. The first operation gestalt of a form property sensor system (the thickness and for curl measurement) [of a form]

Drawing 2 shows first operation gestalt 100a of the form property sensor system 100 in which measurement with the thickness of a sheet and curl is possible. Wiring between form property sensor system 100a and a controller 38 is not shown in drawing 2 and drawing after this. Form property sensor system 100a contains the form (sheet) property sensor 110 of the pair which countered mutually. This form property sensor 110 is used for all the operation gestalten of a form property sensor system. For this reason, especially in the following explanation, unless it points out, the sensor 110 mentioned here shall be applied to every system 100.

[0019] Each form property sensor 110 contains the member 112 which is combined with the base 114 and prolonged in a longitudinal direction from the base 114. Each base 114 is equipped with the measuring circuit for measuring the include angle theta to the base 114 of this member 112. Measurement of each property is performed while passing a form (sheet) 116 contacting these members 112 in between two member 112 comrades, and making it deform these members 112.

[0020] Preferably, the form property sensor 110 is produced as detailed electric machine mold (MEM mold) equipment using standard semi-conductor batch manufacture and a wafer processing technique. By this approach, form property sensor 110a is producible as equipment of the dimension of millimeter order with several [only] yen manufacturing cost. Although the function top of the form property sensor 110 does not need to be such a detailed dimension like this, if larger-scale equipment is produced using other techniques, the cost per sensor will become high.

[0021] As shown in drawing 2 , it is realizable as a slender arm prolonged in a longitudinal direction from the base 114, but a member 112 is good as for spring 112a, as shown in drawing 3 . Both can produce the member 112 shown in drawing 2 R> 2 and drawing 3 , or member 112a using the ingredient of a low quality amount by processing

in which breathe out a thick metallic-coating layer or the spring beforehand formed on silicon or glass using the sacrifice lower layer for electric anticorrosion (sacrificial underlayer) is joined. Moreover, when not producing the form property sensor 110 with a batch semi-conductor processing technique, a member 112 can be realized by other approaches. In drawing 4 , a member 112 is realized as a plunger 113 carried in the spring 115. In this case, a sheet's 116 passage of on a roller 117 goes up or drops a plunger 113 along with the arrow head 111 in drawing with a spring 115. A plunger 113 is combined at right angles to the base 114 so that it may illustrate. A plunger 113 is combined at a shallower include angle, and you may make it not bar a motion of a sheet 116. The bulb by which a solenoid drive is carried out may be substituted for a plunger 113. The include angle between a member 112 and the base of relation changes with the deflections of the member 112 also according [which case] to a sheet 116. Although the example at the time of realizing a member 112 as an arm is hereafter explained to representation, the following explanation shall be applied to all the operation gestalten of not only an arm but the member 112.

[0022] Drawing 5 shows first operation gestalt 110a of the form property sensor 110. base 114a -- the light source 120 -- it has light emitting diode (LED) and a position transducer 122 suitably. A position transducer 122 detects the light from LED120 deflected with the sensor arm 112. The signal which the location where light shines upon a position transducer 122 changes, consequently is outputted to a controller 38 from a measuring circuit by change of the include angle of the sensor arm 112 and the base 114 to build changes. Drawing 6 shows second operation gestalt 110b of the sheet property sensor 110. With this operation gestalt, a measuring circuit contains the strain gauge 124 combined with the sensor arm 112 and the base 114. A strain gauge 124 may be included in the base 114 attached in the sensor arm 112 and this sensor arm 112, or may be attached between the sensor arm 112 and the base 114. If the include angle between the sensor arm 112 and the base 114, i.e., deflection ** of the sensor arm 112, changes, the signal which the strain detected by the strain gauge 124 changes, consequently is sent to a controller 38 from a measuring circuit will change. A strain gauge 124 can detect a strain using a piezoresistance or piezoelectricity.

[0023] Form property sensor system 100a is measurable in the thickness of a form sheet, and curl using either of the form property sensors 110a or 110b. Between the sensor arms 112, it starts from the condition that there is no sheet 116, and measurement of the thickness of a form calculates differential offset displacement thetaoffset. It is theta offset=theta 1 offset-theta 2offset. Then, differential displacement thetawp is calculated in the condition that a form 116 is between the sensor arms 112. It is theta wp=theta 1 wp-theta 2wp. The thickness of a form 116 is called for by the controller 38 using thetawp and thetaoffset. differential [in / on the other hand, measurement of curl of a form is in the condition which has a form 116 between the form property sensors 110 first, and / the 1st time amount] -- a variation rate thetatau1 is measured. the 2nd time amount which is still between the sheet property sensors 110 although a form 116 begins migration from there -- setting -- differential -- a variation rate thetatau2 is measured. A controller 38 searches for the difference of thetatau2 and thetatau1 as an indicator of curl of a sheet. It turns out that curl is so large that this difference is large.

[0024] C. The second operation gestalt of a form property sensor system (for form mass measurement)

Drawing 9 shows operation gestalt 100b for form mass measurement of the form property sensor system 100. System 100b includes the modification of the form property sensor 110 in which the position control of the sensor arm 112 is possible. The example of a

complete-change form of form property sensor 110c of drawing 7 is shown in drawing 9 . This form property sensor 110c is equipped with the perpendicular actuator 126 combined between the sensor arm 112 and the base 114. The perpendicular actuator 126 may be used together with one of the measuring circuits which was explained according to drawing 5 and drawing 6 . There are for example, a piezo-electric bimorph element, a linear piezo-electric element which the mechanical amplifier attached, a bubble drive mold micro piston, etc. in a device available to implementation of the perpendicular actuator 126. Form property sensor 110d as shown in drawing 8 may be used for form property sensor system 100b, and, instead, the linear actuator 119 for moving an arm 112 is used instead of the perpendicular actuator 126 in that case.

[0025] Form property sensor system 100b includes the circuit 140 for detecting a motion of the sensor arm 112. A circuit 140 gives the output of a strain gauge 124 to an operational amplifier 142. an operational amplifier 142 -- difference -- it functions as amplifier. A low pass filter 144 separates the high frequency component of the differential signal outputted from the operational amplifier 142, and enables a faithful feedback trace. Then, after the analog output from a filter 144 is changed into a digital signal by the A-D converter, it is sent to a controller 38. An A-D converter may be incorporated into a controller 38.

[0026] In order to perform form mass measurement using form property sensor system 100b, a signal is first given from a controller 38 to an actuator 126, and the normal impact force of the fixed amplitude is applied to the sensor arm 112 in the condition that there is no form 116 between the sensor arms 112, according to this signal. And differential displacement (differentialdisplacement) thetabase is detected by the measuring circuit, and it is sent to a controller 38, and becomes comparison criteria. Then, the normal impact force of the as same magnitude as the point is applied to the sensor arm 112 in the condition that a form 116 is between the sensor arms 112, and it is differential displacement thetaload. It is detected. A controller 38 takes the difference of thetabase and thetaload and presumes the mass of a form 116.

[0027] D. The third operation gestalt of a form property sensor system (curl of a form, and for rigid measurement)

Drawing 10 shows operation gestalt 100c curl of the form sheet of the form property sensor system 100, and for rigid measurement. the sensor pair which consists of a form property sensor 110 by which this form property sensor system 100c countered -- 150 and 152 are included. A perpendicular actuator or a linear actuator may be added to the form property sensor 110 so that a member 112 and a form 116 may contact certainly. the sensor pair which is a pair of the form property sensor which counters in order to ask for curl of a form sheet using system 100c -- the condition that a form 116 is between 150 and 152 -- differential -- a variation rate is detected to coincidence by both sensor pairs. two obtained differential -- a variation rate -- the difference of a between serves as an index of curl of a form, and it is used for modification of the copying machine 9 by the controller 38 of operation. Moreover, if the first sensor pair of the form property sensor 110 is equipped with the perpendicular or the linear actuator, form property sensor system 100c can also perform rigid measurement of a form. first, the form 116 -- a sensor pair -- the condition of being in contact with both 150 and 152 -- a sensor pair -- normal force is applied to 150. while [and] the normal force is still applied -- a sensor pair -- the differential of the sensor arm 112 of 152 -- a variation rate is measured. in this way, the detected differential -- a variation rate serves as an index which shows the rigidity of a form 116.

[0028] E. The fourth operation gestalt of a form property sensor system (for thermal-

diffusivity measurement of a form)
Drawing 11 shows 100d of fourth operation gestalt of the form property sensor system 100. This system 100d, the thermal diffusivity of the form sheet 116 can be measured directly, and that coefficient of friction can be measured indirectly. Form property sensor system 100d, the form property sensors 110d, 110e, and 110f are included. The form property sensors 110d and 110e face each other perpendicularly, are arranged, on the other hand, sensor 110f, open sensor 110d and spacing and are arranged horizontally. Form property sensor 110d, it has the heater 160 attached in the sensor arm 112d edge in contact with a sheet 116. A heater 160 is a resistance mold heater which is installed on sensor arm 112d, or is included in this sensor arm. A heater 160 is driven according to sinusoidal current or the impulse current. The form property sensors 110e and 110f are equipped with the temperature sensing devices 162e and 162f installed on the sensor arm 112, respectively, and it is made for these temperature sensing devices 162e and 162f to be touched by the form 116. The temperature sensing devices 162e and 162f are realizable as a thin film thermocouple or a temperature sensing resistor. A perpendicular or a linear actuator may be added to the form property sensors 110d, 110e, and 110f so that the sensor arms 112d, 112e, and 112f and a form 116 may contact certainly. Moreover, thin layer coating is given with Si3N4 or a diamond on the sensor arms 112d and 112e and 112f, and you may make it protect this sensor arm group from wear by the form 116.
[0029] In order to detect the thermal diffusivity of a perpendicular or a longitudinal direction, while the form 116 is standing it still, sinusoidal current or the impulse current is added to a heater 160. Then, form property sensor 110e detects the heat given from the heater 160 in between [that the sheet 116 has still stood it still], and generates the signal which shows the thermal diffusivity of the perpendicular direction of a form 116 from thermocouple (temperature sensing device) 162e. Similarly, while the form 116 is standing it still, form property sensor 110f, heat is detected through 162f (temperature sensing device) of thermocouples, and the signal which shows the thermal diffusivity of the longitudinal direction of a form 116 is outputted.
[0030] F. The fifth operation gestalt of a form property sensor system (for coefficient-of-friction measurement of a form)
Drawing 12 shows operation gestalt 100e for coefficient-of-friction measurement of the form 116 of the form property sensor system 100. Form property sensor system 100e is equipped with 162g of temperature sensing devices this sensor 110g including form property sensor 110g. It is realizable device 162g using a thermocouple or a temperature sensing resistor. If this system 100g is used, coefficient of friction of a form sheet can be indirectly measured by at least three kinds of following approaches.
[0031] In a primary method, form property sensor 110g is made to pass a form 116, and 162g of temperature sensing equipment performs temperature detection of a form 116. The temperature rise acquired is proportional to coefficient of friction and the form rate, the pressure, ambient temperature, and form temperature of a form. Therefore, in order to measure coefficient of friction correctly by this approach, it is necessary to proofread a copying machine 9 according to this factor group, or to maintain this factor group uniformly. By the second approach of measuring coefficient of friction indirectly, a form 116 is first made into a short period of time and a quiescent state, and 162g of temperature sensing devices is proofread. 162g of temperature sensing equipment is made to pass a form 116 after proofreading, and 162g of these equipment is made to detect the temperature of a form 116. The difference between the temperature detected under migration of a form 116 at the time of quiescence expresses coefficient of friction of a

form 116. Moreover, in order to use the third approach, a linear actuator or a perpendicular actuator is added to form property sensor 110g. In case a form 116 passes form property sensor 110g with constant speed by this, the sensor arm 112 is moved to a longitudinal direction along with a form 116 by the actuator. If theta is measured at the time of this actuation, the index of coefficient of friction will be obtained.

[0032] If the temperature sensing device 162 is omitted, it is deformable so that coefficient of friction can be measured directly for system 100e. In order to measure a request, a form 116 is maintained at a quiescent state, form property sensor 110g, it crosses a form 116, is pushed (meeting) and measures the amount theta of displacement which expresses coefficient of friction between them.

[0033] Drawing 13 shows form property sensor system 100f too usable to indirect measurement of coefficient of friction. Independent form property sensor 110h without a thermocouple is included system 100f. Unlike the form property sensor explained so far, the shaft of the longitudinal direction of the base 114 is established at right angles to the front face of a form 116. In order to measure coefficient of friction of a form using this system 100f, a motion of the longitudinal direction of a form 116 is adjusted in the condition of having made form property sensor 110h fixing. Then, the deflection of the sensor arm 112 arises for friction association by the form 116 and the reaction of an arm 112.

[0034] G. The sixth operation gestalt of a form property sensor system (the dielectric constant and for resistance measurement) [of a form]

Drawing 14 shows the dielectric constant of the form 116 of the form property sensor system 100, and 100g of operation gestalten for resistance measurement. Form property sensor system 100g, the form property sensors 110i and 110j by which the pair countered are included. Both of the sensors 110i and 110j are equipped with the perpendicular actuator 126 for contacting a form 116 certainly. The perpendicular actuator 126 is omissible if needed. Moreover, each form property sensors 110i and 110j equip the edge of the related sensor arm 112 with Electrodes 170g and 170h, respectively. Both the electrodes 170g and 170h contact a form 116.

[0035] In order to measure a dielectric constant, a sine wave or impulse voltage is applied to 170g of electrodes, and the electrical potential difference is driven to 170h of electrodes through a form 116. The current of the different phase detected by 170h of electrodes is proportional to the electrostatic capacity between 170g-170h of electrodes (capacitance). From electrostatic capacity C and a dielectric constant epsilon, it can ask according to a degree type.

[0036]

[Equation 1] C=epsilon A/d -- here, A expresses an electrode surface product and d expresses the thickness of a form.

[0037] Thickness d of a form 116 can be measured using the approach shown in drawing 2 to, have explained form property system 100a by the way.

[0038] Resistance of a form 116 is measurable by detecting a current in phase by 170h of electrodes, applying a sine wave or impulse voltage to 170g of electrodes too. It depends for this current showing resistance greatly to the temperature of the moisture regain of a form 116, and the second form 116 in the first place. Therefore, a copying machine 9 keeps these amounts constant, or needs to be proofread in accordance with these amounts. Instead a controller 38 can use change of the current detected by 170h of electrodes, and the moisture regain and temperature of a form 116 can also be presumed.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the copying machine with which the form property sensor system concerning this invention is applied.
[Drawing 2] It is drawing of the operation gestalt for the form thickness of a form property sensor system, and curl measurement.
[Drawing 3] It is drawing of another operation gestalt about the member of a form property sensor.
[Drawing 4] It is drawing of still more nearly another operation gestalt about the member of a form property sensor.
[Drawing 5] It is drawing of the first operation gestalt of a form property sensor.
[Drawing 6] It is drawing of the second operation gestalt of a form property sensor.
[Drawing 7] It is drawing of another operation gestalt of a form property sensor.
[Drawing 8] It is drawing of still more nearly another operation gestalt of a form property sensor.
[Drawing 9] It is drawing of the operation gestalt for form mass measurement of a form property sensor system.
[Drawing 10] It is drawing of the rigidity of the form of a form property sensor system, and the operation gestalt for curl measurement.
[Drawing 11] It is drawing of the thermal diffusivity of the form of a form property sensor system, and the operation gestalt for coefficient-of-friction measurement.
[Drawing 12] It is drawing of the operation gestalt for the direct measurement of coefficient of friction of the sheet of a form property sensor system.
[Drawing 13] It is drawing of the operation gestalt for indirect measurement of coefficient of friction of the sheet of a form property sensor system.
[Drawing 14] It is drawing of the operation gestalt for dielectric constant measurement of the sheet of a form property sensor system.
[Description of Notations]
38 A controller, 100 A form property sensor system, 110 A form property sensor, 112 A sensor arm, 114 The base, 116 Form.